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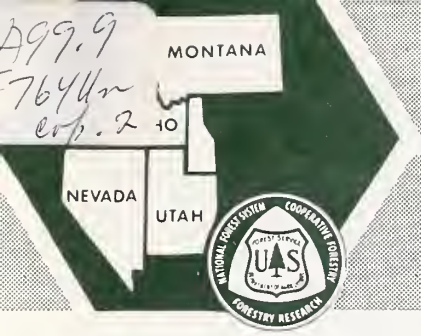

Research Note

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SHOOT DEVELOPMENT IN YOUNG ASPEN

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ABSTRACT

The effect of branching on second-year terminal growth of rooted sucker cuttings was studied in fourteen aspen clones. Cuttings with lateral shoots made significantly less growth than cuttings without lateral shoots. In cuttings having lateral shoots there was a negative correlation between second year growth and numbers of lateral shoots.

KEYWORDS: *Populus tremuloides*, trembling aspen, shoot growth, branching, rooted cuttings, clonal variation.

In a recent study of vegetative regeneration of aspen (*Populus tremuloides* Michx.) following burning and clearcutting, it was found that the amount of height growth of root suckers was much less during the second growing season than during the first (Schier and Campbell 1978). This may have been due to the depletion of reserves in the parent roots. The reduction in height growth during the second year, however, may have also been due to the outgrowth of lateral buds (inhibited the first year[2]) and the consequent competition between terminal and lateral shoots for the limited supply of water, minerals, and photosynthates.

The effect of branching on terminal growth of aspen can be studied by comparing second year growth of rooted sucker cuttings with and without lateral buds. Cuttings without lateral buds are common in some clones because shoots set terminal buds and become dormant during rooting, prior to the initiation of lateral buds. The axils of primary leaves on these cuttings do not have buds. Cold treatment is necessary before shoot elongation will continue. Cuttings that do not go dormant during rooting continue terminal growth and develop a shoot with lateral buds, which elongate during the second year. In clones with high variability in the numbers of lateral shoots, effect of branching on terminal growth may also be shown by a regression of terminal growth on numbers of lateral shoots.

Terminal shoot growth in aspen involves the elongation of preformed stem units in the winter bud (i.e., fixed growth) followed by a period of free growth during which the initiation and elongation of new stem units occur simultaneously.

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[2]It is normal in aspen for the lateral buds on the current year's growth to be completely inhibited.

METHODS

Roots for vegetatively propagating aspen were collected in May 1976, from 20 aspen clones growing in Logan Canyon east of Logan, Utah. Suckers were grown from root segments and sucker cuttings rooted by the methods described by Schier (1978). During the last week in July, 30 cuttings having the best root systems were selected from each clone and planted in 6.4 by 25.4 cm tubes with a vermiculite:peat moss (1:1) potting mix. The containerized aspen were randomly placed on a greenhouse bench where they were fertilized with a complete granular fertilizer and watered periodically. To increase the amount of growth made by the ramets during their first year, day lengths were extended with artificial lighting from August 1 to October 26. Most ramets continued to grow during the long days; however, a significant number set terminal buds during rooting and went dormant. On October 26 the ramets were moved to a "cold" compartment 34° to 46°F (1° to 8°C) in the greenhouse.

During the second week in April 1977--prior to flushing--the ramets were transplanted into 1-gallon pots with a peat moss:sand (4:3) potting mix and fertilized. They were moved outside to a lath house (50 percent shade) where the clones were randomly arranged on benches, and the plants were watered as needed to keep the soil moist. In October, after leaf fall, terminal shoot growth increments were measured and numbers of lateral shoots counted.

Bud set during rooting of cuttings occurred with greater frequency in some clones than others. Those clones in which bud set was common were used for comparing terminal growth increments of ramets with and without lateral shoots. Clones in which many of the ramets made good first-year growth were used for determining the relationship between second-year terminal growth and number of lateral shoots.

RESULTS

Second-year terminal growth increments of ramets with lateral shoots were significantly less than those without lateral shoots (table 1). The reduction in growth of terminal shoots caused by the presence of laterals ranged from 33 percent in clone 2 to 66 percent in clone 4. The second-year height increment made by ramets without lateral shoots enabled them to make up for their poor growth the first year caused by early bud set. Therefore, by the end of the second year, none of the clones showed a significant difference in total height between the two classes of ramets.

Table 1.--*Second year terminal growth of aspen ramets with (a) and without (b) lateral shoots on the first year's stem growth*

Clone	Mean and range in numbers of lateral shoots	Mean terminal growth	
		First year	Second year
		Centimeters	
1	a. 6.4 ± 1.9 (3-10)	52.3 ± 9.7	46.7 ± 10.8 **
	b. 0	2.4 ± 0.9	94.9 ± 24.0
2	a. 3.8 ± 2.8 (1-10)	28.7 ± 12.3	62.5 ± 26.6 **
	b. 0	3.3 ± 1.1	104.8 ± 16.7
3	a. 2.3 ± 2.2 (0-6)	38.3 ± 10.8	64.6 ± 29.2 *
	b. 0	5.3 ± 4.4	83.6 ± 16.0
4	a. 7.6 ± 2.4 (4-13)	57.2 ± 10.2	51.1 ± 16.0 **
	b. 0	2.4 ± 1.2	115.4 ± 15.7
5	a. 4.8 ± 1.8 (1-7)	41.7 ± 9.6	58.1 ± 9.3 **
	b. 0	3.1 ± 1.7	88.3 ± 17.2

*/** Differences between ramets with and without lateral shoots that were significant at 5 and 1 percent levels, respectively.

To determine if top growth of larger plants had been reduced by restricted root growth, the root systems of a small sample of plants in each clone were examined. There was no evidence that root spiraling had become severe enough to reduce root vigor.

The relationship between terminal growth and number of lateral shoots was examined in nine clones (table 2). There was a significant positive correlation between the number of branches borne by the portion of the stem elongating the first year and the first-year height increment. This would be expected because the number of nodes on the stem, where leaves and lateral buds occur, is determined by the amount of stem growth. (Within a clone, mean internode length during height increment of a given year did not show much variation. Less than 20 percent of the variation in terminal growth was due to an increase in internode length.) The primary cause for the variation in correlation coefficients among clones was the variation in numbers of lateral buds breaking dormancy. Clonal differences in numbers of lateral branches were highly significant (1 percent level).

Table 2.--*Terminal growth and number of lateral shoots on 2-year-old aspen ramets and relationship between stem growth and branch number (correlation coefficient). Lateral shoots occurred on the part of the stem elongating the first year*

Clone	Mean terminal growth		Mean and range in numbers of lateral shoots	Correlation coefficients (r)		
				Branch No.[1]		Second year growth
	First year	Second year		First year growth	df	Branch No.
	- - - *Centimeters* - - -					
6	36.8 ± 8.6	44.6 ± 18.8	5.5 ± 3.5 (0-12)	0.24	18	-0.88**
7	47.9 ± 11.4	40.1 ± 14.1	10.4 ± 4.3 (2-16)	.86**	25	-.71**
8	31.0 ± 13.1	84.3 ± 28.8	6.2 ± 3.1 (2-12)	.79**	17	-.64**
9	43.0 ± 8.8	62.1 ± 23.6	5.4 ± 2.7 (0-11)	.62**	18	-.50*
10	46.9 ± 11.0	66.0 ± 20.0	7.1 ± 3.6 (3-15)	.48*	21	-.54**
11	33.8 ± 9.0	46.4 ± 17.1	4.6 ± 3.3 (0-13)	.51**	24	-.75**
12	52.3 ± 9.7	46.7 ± 10.8	6.4 ± 1.9 (3-10)	.54*	16	-.34
13	42.0 ± 9.2	82.4 ± 16.6	3.5 ± 2.0 (1-6)	.67**	12	-.44
14	57.2 ± 10.2	51.0 ± 16.0	7.6 ± 2.4 (4-13)	.58*	12	-.59*

*/** Significant at the 5 and 1 percent levels, respectively.
[1] dependent variable / independent variable

Second year terminal growth showed a significant negative correlation with the number of lateral shoots in seven of the nine clones (table 2). Because the number of branches was determined by the first-year height increment, second-year terminal growth was also negatively correlated with first-year shoot growth. In other words, the greater the ramets grew the first year the less they grew during the second. This compensating mechanism tends to reduce the variation in total height of ramets within a clone during early growth.

Second-year terminal growth was also negatively correlated with the total length of lateral shoots, but the relationship was not as clear as that between shoot growth and branch number.

DISCUSSION

The results presented in this study indicate that annual height increment of aspen root suckers decreases during their second year because of the outgrowth of lateral buds. This is not surprising because the various growth processes that proceed simultaneously in a plant are not independent, but closely linked with one another. To some extent these growth correlations--as they are often called--can be attributed to the availability of nutrients, or food factors, and the competition between growing regions for these substances. Reduced terminal growth of aspen ramets during crown development may also be the consequence of internal water deficits (Borchert 1975). Branching increases the total leaf area and therefore causes a greater loss of water by transpiration.

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